Charting a Course for a Successful Research Career

A Guide for Early Career Researchers

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Foreword

Being a researcher today is a bit of a dichotomy. On one hand, researchers now have easier and quicker access to an unprecedented amount of information from around the world, through tools such as Elsevier's Scopus and ScienceDirect databases. Global communications technology allows collaboration on the individual, national, and international levels like never before, which facilitates the research process as a whole from the funding stages through discovery and publication. On the other hand, they are working in the most competitive research environment ever known. Grant applications are increasing, funding opportunities are decreasing, and funding bodies are tightening the reins around their requirements and expected outcomes. The dichotomy is that researchers have better, broader, and faster access to more information and technology than at any other time in history, yet the funds necessary to tap into these resources and fulfill the full promise of research are lean and growing leaner.

Early career researchers are especially affected by this dichotomy. Having learned their research skills and earned their Ph.D.s in this new age, they are keenly aware of its potential. However, without the benefit of years of experience under their belt they are often at a disadvantage when applying for grants. Though they are new in the field and full of fresh perspectives, funding bodies are often hesitant to award grants to junior researchers without the presence of senior researchers on their teams. With more experience comes more responsibility, which can leave veteran researchers little time, incentive, or energy to guide their novice peers. Without funding, early career researchers are at risk of reducing their productivity and contributions. Without mentoring and guidance, they may take unnecessary career detours.

Nations, governments, industry, and academia all have a responsibility to support our early career researchers. Ultimately, we at Elsevier see our role as being a solutions provider - providing the tools that let these researchers share their knowledge with the research community, publish their works and validate their results, evaluate the work of others', find funding and potential collaborators, and determine their research path as well as the impact of their work. But first and foremost, a plan for building a successful research career must be in place. Professor Johnson's guide provides the building blocks essential to a strong foundation.

Jay Katzen
Managing Director, Academic & Government Products, Elsevier

Introduction

Congratulations!

You have worked hard over the last few years to complete your doctorate (Ph.D. or equivalent such as, for example, the Dr.rer.nat. in the German - speaking community, or D.Phil.) or you are in the process of completing it. You now have the skills, expertise, and above all the international recognition to embark on a research career.

Over the last five to 10 years, competition for high profile research positions has become much more competitive. There is no substitute for an outstanding research record. But as a researcher who is beginning your research career, you must also plan and work on a number of important activities that complement your research record in order to optimise your research career. You need a plan and this guide outlines the major points to consider as you chart the course that is best for you.

Although this guide speaks to early career researchers (ECRs), it is also very important that senior researchers and senior research managers are aware of the mentoring and assistance that ECRs require these days. Therefore, you should either direct them to this guide or pass your copy on to them after you finish reading it.

A guide about international research mentoring must be very broad, recognising differences among research disciplines, research types, countries, and organisations. For example, different countries have different forms of doctoral training and there are international differences in the official definition of an ECR. Here, I do not subscribe to an official definition of ECR and use the term Ph.D. for all similar internationally recognised research training awards. This guide is written for researchers who are still planning and designing their research career, no matter how much time has passed since the award of their Ph.D.

There are many and great differences among the research disciplines. Humanities and creative arts researchers tend to work on their own or in small highly focused groups. They often need fewer physical resources, such as research maintenance funding, than researchers in other discipline areas. At the other end of the spectrum, large biological science groups or physical science research centres that require large amounts of funding for both purchase and maintenance of very large research infrastructures are probably most common.

Similarly, there are numerous differences among the types of research done within these disciplines. The European Union uses the Frascati definition of researchers as ***"Professionals engaged in the conception or creation of new knowledge, products, processes and methods and systems, and in the management of the projects concerned."*** [1].

Research is often divided into three broad research types.

1. Pure basic research - experimental and theoretical work often called fundamental or "blue sky" research, "knowledge for knowledge's sake."

2. Strategic basic research - experimental and theoretical, but often undertaken to acquire new knowledge and lead to useful discoveries or solving practical problems.

3. Applied research - original work to perhaps determine new ways of achieving specific objectives or developing new techniques.

The last major challenge that a relatively small internationally focused guide such as this one faces is the fact that the different types of research within the different disciplines are often carried out in different types of organisations. In addition to public and private universities, researchers work in a broad range of non - university institutions such as government research institutes, private research institutes, not-for-profit organisations, medical research institutes, and private commercial and industrial research companies.

I accept all of these differences and intend this guide to apply to the tens of thousands of researchers who may work in different research disciplines, in different research organisations, and do different types of research in different countries. So whether you are a physics researcher for a German company, a law researcher at a Brazilian university, or an arts researcher in a Japanese government research institute, I am sure that you will get enormous benefit from this guide. And of course, research is an international occupation so that even if today you are a researcher in a national government institute, next year you may accept a position at a university on the other side of the world. The Ph.D. and equivalents are internationally recognised qualifications. Having the ability to plan for a global research environment is an ideal aim for all ECRs.

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Career Planning

Those of you working at universities also have responsibilities in teaching, community service, and internal administration. Researchers in research institutes or those working for commercial companies also have a range of other responsibilities to fulfill in addition to their research. Very few researchers, especially at the onset of their careers, are able to concentrate solely on their research. There are plenty of other demands on your time, but this guide does not attempt to plan an academic or commercial career in its entirety. It must necessarily focus on the research component of these careers, but it does attempt to take the other demands on your time into consideration.

It is largely up to you to decide how much time and effort you spend on these other demands. In fact, because of them, it is probably even more important to include them strategically as you chart your research career path.

You need a plan. Stages in the plan may never come to fruition, may change quickly, experience problems, or even proceed quicker than originally thought, but all of these issues can be addressed and the plan revised accordingly to help you achieve your research goals. Having a plan that needs to be adjusted over time is better than not having any plan at all.

Whatever you do, make your choices about the paths you take based on informed decisions. No longer is it competitive to have a Ph.D. and let your research career "drift" based on what comes your way. You must be proactive rather than reactive in how you approach your research career. In fact, even those of you who may decide to focus more on teaching, community service, or commercial outcomes in research should use a plan for those areas as well.

Perhaps the first step to formulating a plan for your research career is to ask yourself where you want to be in five, 10, or 15 years. Do you wish to stay in the type of organisation and research area you are in now and advance your activity in this area? Do you wish to gain entry into another type of academic or commercial organisation? Or do you wish to change research fields? These are major decisions. They are within your control, but only you can decide what you want to do.

Your research plan and your goals need to be optimistic and ambitious, but they must be realistic too. The research environment is extremely competitive internationally and while success should be attainable by everyone, and certainly having a plan for your research career will bring you closer to your goals and success, it is important that your goals are reachable. The following sections will help you to achieve this balance.

It is not the aim of this guide to review general personal and management skills, but perhaps one skill that should be stressed here is the ability to sensitively say "no" when appropriate or necessary. There may well be situations where you should say "yes" to avoid any potential negative impacts in the future. However, "yes" does not need to be your standard answer. Again, it is a decision you need to make based on the prevailing conditions at the time. Certainly, a researcher in the academic area receives many requests to serve on internal committees or boards that may advance one's academic career, but not necessarily your research career. Though these boards and committees are important in how universities, research institutes, and commercial companies conduct their activities, you need to make the decision that being on that board and performing your role to the best of your ability is what you want to do, even if it detracts from your research productivity. If you are more determined to focus exclusively on your research career then you need to make a decision that you will not accept appointments to these types of boards or committees.

There are various boards and committees that are important to research careers. Being a peer reviewer, i.e. membership of an editorial board or grant review panel, is good for visibility and prestige (to add to your curriculum vitae [CV]). It's also an excellent learning experience as you critically assess the works of others and learn in the process how to structure your own research better or write a better grant proposal or publication yourself.

Of course, while the research career is important, even outstanding researchers live within a social context and establishing an appropriate work/life balance is extremely important. Many outstanding researchers are excellent teachers and have busy personal and professional lives in addition to their research careers. This is often brought about as a complement to their increasingly productive research outputs and is probably facilitated by the personal and management skills they have used and honed throughout their research career.

Of course, much depends on your hard work. While work/life balance is important, it is up to you to decide how much time you allocate to each part of your research career. But no matter what type of research you do for whichever organisation type, there is really no substitute for focused, well planned, and therefore very efficient, hard work. As will be explained in the following sections, the hard work I am talking about should be in the planning for excellent research, so that when the laboratory experiments, literature analysis, or creative work is begun, the amount of effort required is reduced to the appropriate minimum. Perhaps it should be called working smarter, not harder. The information in this guide will help you work smarter.

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Selecting a Research Discipline Area

You have spent three or more years often working long days and nights for six or seven days a week in order to ensure the excellence of your Ph.D. You are the world expert in your chosen Ph.D. field of early Babylonian linguistics or the economic history of ukiyo-e Japanese block prints. Perhaps you have discovered new theories on galaxy creation in astronomy or you are the only person in the world that knows the sequence of a specific Severe Acute Respiratory Syndrome (SARS) virus gene. Such research outcomes of your thesis are clearly very important, but that is not what a Ph.D. is about. A Ph.D. is a research training degree and in understanding or investigating your specific research area, you should have acquired and further developed the research skills, training, and expertise to carry out research in a range of similar disciplines.

While Ph.D.s are often very specifically focused, ideally the research produced should be put in an international context. Even very specific local Ph.D. projects should be made worthwhile to at least the discipline specific community to increase its relevance to a broader group besides you, your family, and your Ph.D. supervisor and examiners. This is even more important later in your research career. Within your chosen discipline, your research should be of interest to the wider research community and it should always be excellent research, which has impact beyond a local interest group. Excellent research should have:

- Well planned and defined hypotheses/aims
- Comprehensive and accurate technical experimentation /data collection
- Objective data analysis and interpretation
- Innovative new findings widely accepted by at least the discipline specific research community

While the vast majority of Ph.D. graduates continue their research career with their Ph.D. research subject or discipline area, now is a good time to reflect on whether that is really what you want to do.

There are many advantages to continuing your research career on exactly the same subject as your Ph.D. program. These include the fact that you may have already published from your thesis, you are well - known in this research area, and your supervisors, fellow graduate students, and even Ph.D. examiners provide a network that gives you entry into an established research environment.

However, you may have chosen the area for your Ph.D. program based on a number of factors that have now changed or almost certainly will change in the future. Across all disciplines, research is rapidly evolving and changing based on increasing competition, funding levels, importance for society, and national and international popularity. A number of countries are focusing their research areas by such activities as the Research Assessment Exercise (RAE) (to be called the Research Excellence Framework [REF]) in the United Kingdom, the Excellence for Research in Australia (ERA) program, and Exzellenzinitiative des Bundes in Germany. Although it may not be the major reason for pursuing these initiatives, these national and international programs are affecting how research is being carried out today and will certainly do so in the future.

Will the same opportunities and resources be available to your research discipline area, and therefore you, in five or 10 years? Even though you may be very happy with your environment at present, how will future changes in the area affect your research career?

This is not to say that you should immediately and dramatically change your research field or discipline, although there are examples of such extreme situations. I am personally aware of some Ph.D. graduates who completed a Ph.D. in physics after finishing one in mathematics. I completed a M.A. (Hons) in technology and social change and an M.Ed.Mgmt. in educational management after my Ph.D. in parasite immunology to broaden the social science facets of my research career.

What I am suggesting is that you should at least consider the current circumstances in your research field and try to assess what is likely to happen over the next few years. It may be that you decide, as most ECRs do, to continue and expand on your original Ph.D. research field. But, it may not be.

Obviously, a dramatic change in your research field may not be appropriate. There are now a number of previously defined and distinct research areas coming together in cross - disciplinary ways. Recent Ph.D. graduates who have learned and perfected a range of research skills during their research training Ph.D. program should not be restricted to continuing their thesis work, but instead can expand their research career into another series of different but

related areas. You can use SciTopics [2] to stay up-to-date in your field and get a quick overview of topics outside of your area of expertise without having to search multiple websites. SciTopics is a free expert - generated knowledge sharing service for the scientific community. It serves as an information and collaboration service for researchers and is an excellent way to assess which disciplines are interacting and how.

Whatever you do, it is up to you to make an informed choice. It will be too late in 10 years to say, "I wish I had gone into that area rather than this one." Clearly it is not easy to accurately "crystal ball gaze" the future of research areas, but one can make reasonably informed judgments based on commercial and policy developments in your country or other countries where you might wish to work in the future. Which research areas are your major national funding agencies exploring? What are your ministers of science/arts/education stating in their press releases? Where are your country's major commercial companies investing their research funds? There are several online databases where you can find this information but the most comprehensive source is SciVal Funding [3]. Created specifically to support researchers in the pre - award stage, SciVal Funding can help you analyse the funding environment. You can access award data for funding performance measurement, evaluation, and strategic planning, learn what publications are linked to certain funding programs, gain insight into funding history to see which researchers and research received funding in the past, and find collaborators and learn about potential competitors.

There are numerous differences, such as resources and time, among research fields that can affect your selection of a productive, enjoyable, and rewarding research career. Some research areas are highly popular in the lay community and attract publicity and consequent government and commercial investment. Others are more specifically defined and may not be considered as "hot." Although they may be very well grounded, highly structured and highly regarded research disciplines that have produced outstanding outcomes over the last few hundred years, they may have simply "gone out of fashion." Research trends that are popular or are becoming more so are easily identified on Scopus [4]. ***Scopus is the largest abstract and citation database of peer - reviewed literature and quality web sources with smart tools to track, analyse and visualise research. By analysing citations for journals and authors, you can gauge the impact of research areas and the influence authors and journals have on research trends today.*** Research trends do wax and wane, and can be, perhaps appropriately, more popular in some countries than others. This could provide advantages or disadvantages, but it does highlight the great diversity of resources among research areas and how you should be aware of this possibility when planning your career.

Experiments in some areas such as astronomy require enormous infrastructure resources and can take years to complete. Even in biological areas, there is significant diversity in timelines. Veterinary science involving large animal field trials or large - scale ecology studies can take much more time, potentially years, than laboratory bench - based molecular biology studies, which can be productive in months or even weeks.

Most Ph.D. graduates start their research career in an area that they are interested in and passionate about. This specific area will remain their focus, but their interest and passion may evolve over time beyond their Ph.D. project area.

Of course, if you are working in a commercial company or government research institute, the projects that you are given to research may have drivers behind them other than your personal interest and passion. This is often balanced by increased relatively easy to obtain internal resources and a more permanent employment situation. Academics at universities do have freedom in their choice of research areas, but as mentioned before, academic research is often balanced with teaching and administration duties. These are all are very important issues that you need to take into account when strategically planning your career. As a minimum, try to weigh the advantages and disadvantages of continuing your research career in the same area for the next 10 or 20 years because it is much easier to make a change now than in five or 10 years time.

Perhaps the last major factor of importance in your research career is to consider whether you wish to work in large teams or more independently. There are advantages and disadvantages to both approaches. It depends on where you do your research, and above all, who pays for you and your research. If you have the opportunity, you need to seriously consider the size and type of research team with which you work.

There is now detailed research showing that team or large group approaches are becoming almost the norm in science, engineering, and technology, but they are also becoming much more common in the humanities and social sciences.

The percentage of single - author publications in astronomy, physics, chemistry, and biology has fallen exponentially over the last 40 years [5] as increasingly complex research questions in science require more multidisciplinary expertise and/or resources applied to find solutions.

This need for the formation of research groups and the increasing size of research groups is widely known and accepted in science. However, it has also been occurring in mathematics, economics, and sociology. Perhaps even more surprisingly, the growth rates of social sciences and arts and humanities team sizes have been almost as large as those of science and engineering [6]. The formation of larger teams in research disciplines as diverse as social psychology, economics, ecology, and astronomy evolves with time, probably up to an optimal size [7]. There are now major international research investigations into what, why, and how research teams form and evolve [8,9]. Tools are being developed to build and analyse scholarly networks [10]. *2collab* [11] *works as a social bookmarking site where you can store and organise your favourite Internet resources such as research articles from any publisher, blogs, web sites, and more. Then, in private or public groups you can share your bookmarks with your colleagues, research team, or the wider pool of experts in your field. Members of the groups can evaluate these resources by adding ratings, comments, and their own bookmarks.*

For example, there are certainly good general arguments concerning research and scale. *"First the intellectual environment created; second the per capita marginal costs of research administration and support personnel; third, the cost of major equipment and facilities; fourth, synergy and overall acceleration; and fifth, the supportive research training environment"* [12]. However, as recorded by an analysis for Universities UK [13], *"Size alone is not a barrier to performance and there is no universal pattern in our data that links better research with bigger units. Big units on average carry out better research than smaller units, but the average for small units includes some that perform at a standard comparable with the largest. ---- There is no general evidence to support the widely held supposition that bigger units necessarily do better research."*

"There may be an optimal size for research units at the level of teams and an optimal group size around 5–8 may be common. This optimal group size appears to hold for a very wide range of information processing systems." [14;15].

However, establishing the structure and organisation of a research team, though challenging and highly worthwhile, will still depend largely on the people and processes used within the structures to produce the research results [16].

This guide doesn't have the space to go into the sociology of research team formation or function. It is mentioned here only to highlight the fact that nowadays, no matter which area of internationally competitive research you work in, or where, it is very likely that you will need to consider your role and position on such a team if you choose to belong to one. It is another major decision you need to make when planning your research career.

Each government or industry research team and university research centre or institute has a director or head. Whether it is this person or a research team leader who reports to the director or head, you will have a research supervisor. You need to give significant thought to which team you join and how its head - your research supervisor, may affect your research career.

Supervisors may not all be "super", but they should at least wisely advise you based on their own personal experience and expertise.

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Selecting a Supervisor

Your Ph.D. has been a research training degree, and to some extent, an apprenticeship in learning and improving your skills in carrying out research. However, even after you are appointed to your first position as a postdoctoral researcher, a researcher for a research organisation, or as a junior lecturer/assistant professor, you are still very much considered an apprentice. This applies no matter what research discipline area you work in, although there are subtle differences between the fields.

My comments so far have been about choosing your research discipline, research area, and whether to join a large team or conduct research more independently. However, a major factor and perhaps the prime factor to consider in planning your research career, is selecting your research supervisor.

Your supervisor could be your Ph.D. supervisor and often is. Your Ph.D. supervisor has worked with you for many years. You have developed a successful working research relationship, as demonstrated by the fact that you were or are about to be, awarded your Ph.D. You may have published and presented at conferences together and a mutual respect has developed between you. When your Ph.D. supervisor either gets commercial funding for a new position or a research funding agency grant, you are well - prepared both personally and research - wise to fit into the program quickly and easily. This also indicates that you have decided to continue your research career in the same area that you did your Ph.D. in or some similar area since they are both supervised by your Ph.D. supervisor.

However, it is often the case that some Ph.D. supervisors, especially the more successful ones, have more students than they can accept for paid research positions. Many Ph.D. supervisors like to see their Ph.D. students move organisations and take up postdoctoral positions in high profile institutions or universities overseas.

Perhaps in selecting a research supervisor you should consider what Robert Merton identified as the "Matthew Effect" in as early as 1968 [17]. It is the phenomenon that fame breeds fame, that often cited papers are cited more often, and that influential authors gain more influence. This phenomenon has been tested across many different disciplines using a number of different parameters to measure success in research such as citations to publications [18,19] and quality and number of publications and research funding success [20,21]. Applied mathematicians or engineers would consider the Matthew Effect as a positive feedback effect and if you can get into a position where your supervisor is someone who is highly recognised internationally, then the benefits of the Matthew Effect are likely to be positive for you and your research career. Although there is never any substitute for research excellence, the understanding of some of these sociological aspects of research can be a major benefit to your career.

However, as Tol [22] suggests, ***"The results confirm that it is a hard journey from being an unknown upstart to a famous economist. Famous elders hog the limelight, and their share of the attention is only partly due to superior quality; some are rather famous for being famous. However, it is not uphill all the way; it is uphill only for most of the way. At a certain point, one crosses the threshold and is then propelled to fame."***

As an Executive Director of the Australian Research Council (ARC), I worked with a number of international grant funding agencies and liaised with numerous high profile internationally recognised researchers. Tol's comment regarding elders hogging the limelight is unfortunately not as rare as one might think and so the personality and style of your proposed research supervisor certainly needs to be given much consideration.

Some elder researchers push their younger researchers very strongly, which helps their career substantially. Other supervisors may use their ECRs to increase their own profile often in a symbiotic way, but unfortunately occasionally to the detriment of the ECR's career.

If possible, you need to find out about your potential supervisor's training profile. Perhaps the clearest and most obvious way to do this is at the interview or by talking to them and raising the issue in a sensitive and appropriate way. ***"I am keen to build a high quality research career from my working relationship with you. Could you please describe your supervision and personnel management style, to help me optimise our working relationship?"*** If asked appropriately and at the right time, it is a question that a reasonable supervisor should be happy to hear and can reasonably answer. A good potential supervisor should be appreciative of the fact that you are thinking about these wider aspects of your research career and see it as being a positive indication of your desire to do well.

In addition, you can see potential supervisors in action during conferences or other international forums either personally and directly by attendance at those forums or indirectly via feedback from people who attended the conference and listened to them.

Your Ph.D. supervisor may also know personally or indirectly your potential new supervisor and be able to give advice on your future career plans. It is also theoretically possible to seek comments from other ECRs already working with the person, and perhaps even better, from those who might have left and moved on from working with them. Clearly, this must be done cautiously and in an appropriate way. I am certainly not suggesting that if a high quality, high profile position is offered to you that you, make indiscrete or inappropriate attempts to investigate the personnel style of the potential supervisor. However, it is certainly something that you should attempt to gain some general information on or at least consider. While it may be a high profile position, a strained relationship with your supervisor is not likely to let you excel in that position despite your high quality hard work.

In this case, you might be better off with a team, organisation, or university department where you can, by your own hard work and high quality achievements, advance without having personnel relationship baggage to overcome.

In addition, although the vast majority of research supervisors are ethically above reproach, there are unfortunately too often cases of high profile research fraud [23,24,25]. Appropriate enquiry into the research team, organisation, or university department you are planning to tie your research career to, will be worth the effort.

What I am suggesting is that you perform due diligence on jobs for which you apply and not necessarily take the first job offered to you. You must be proactive in seeking a job and not reactive. This also gets back to the question of whether you prefer to work by yourself in your own research area with more freedom in your academic pursuits or join a larger team and be more likely subjected to directed collaborations and team procedures and policies.

A mentor would be an ideal person to advise you on this.

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Selecting a Mentor

A good mentor who is prepared to give free and open but critical advice on your research career is invaluable. They are rare so not every outstanding researcher has reached their high level of achievement with the help of a mentor. However, if you are able to gain the support and commitment of a mentor, it is highly likely that your research career will be more effective and reach greater heights than if you do not have one.

There are mentoring organisations in some countries that work on a fee-for-service basis and while these may be effective for short - term advice, they are not ideal for a long - term relationship.

It is theoretically possible that your research supervisor could be your mentor. It is unlikely though and there are a number of reasons why this is not a good idea. Your research supervisor, who is intricately involved in the productivity and outcomes of your research, may not be able to provide you unbiased advice that is best for you personally as it may not be optimal for your joint research outcomes. The best mentor is someone who may not even be in the same research discipline or even the same department or organisation. They do not need to have experience in your specific research discipline, just a general understanding of the broader research environment, as they need to be able to give general personal career advice.

Of course, a mentor can only give you advice and suggestions. The path you eventually take is up to you. However, a person who knows you, but is not directly involved in your research can raise comments or suggestions that you may not think of because of your closeness to the work.

The most important factor in identifying a mentor is that they are able to, and will, provide essential critical comment. You and they must have a mutual respect, so that they can advise or suggest that you may be wrong or your ideas or focus may be incorrect. Your mentor may suggest that you need to find another job, that you should be establishing a better work/life balance, or that your research supervisor could be giving you more research freedom or support.

This is perhaps why finding a good mentor is so difficult. There are no obvious reasons for your mentor to spend time and effort with you and perhaps provide advice that is not consistent with a continuing uneventful, but not especially productive job. What do they get out of it? In the short term, most mentors really do not receive much in the way of incentives for their time and effort. But elders, who have made significant achievements over their career and often with the help of their own mentors, may be happy to act as mentors for a small number of ECRs.

It is not essential that you find one, but should the opportunity arise, I strongly suggest that you spend some time trying to find an appropriate mentor. I think their input will substantially assist your research career.

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Research Collaboration

Research collaboration is an essential part of networking. It is so important that I am devoting this section to it and covering the rest of networking in the following section.

Collaboration is a major component of most research productivity. However, it is essential that you collaborate because you have decided that you want to do it and that the advantages outweigh the disadvantages. You must ask yourself why you want to engage in this particular research collaboration and be specific about the aims, process, timelines, and common objectives. If you are not going to get sufficient advantage out of it, do not undertake it, as there will be many more opportunities for positive research collaboration throughout your research career. It is much better to be involved in a few very positive collaborations than a number of ones that are of little value and could even be detrimental to your career.

There are a number of good reasons for considering research collaboration. It may provide you access to new tools, information, and skills and it may give you an international perspective that may take years for you to develop working on your own. Websites such as 2 collab and SciTopics present online opportunities to obtain and provide insights on your research while building and cultivating your network of potential collaborators around the world.

You may need expertise to complement your own. Do you need a Spanish speaker to work with you on your research on the economic history of Cuban cigars? Do you require the gift of a monoclonal antibody to a specific cancer you are trying to cure? Would you benefit from the input of an architect on your research on the social culture of Mayan temple use?

Research collaborations may also assist you in extending your research into other disciplines as described in section 2. Collaboration with an individual or a group of international renown will certainly raise your profile both nationally and globally. Mutual research collaboration could create synergies for you and your collaborators, thereby exponentially increasing the research outputs of both groups.

If it is potentially so valuable to collaborate in your research, then why am I suggesting that it requires serious analysis before you commit to it or undertake it? Of course, much depends on whether you initiated the collaboration or whether the potential collaborator approached you because of your skills and expertise. Will it be a mutually beneficial collaboration or will you and your work be taken over and subsumed?

As an ECR, you are still presumably working in a relatively small group or team or even with just yourself and your research supervisor. Either way, you may be the first author on a two - author paper, or the second author of a two - author paper if your student is the first author.

Author order in such cases is relatively uncomplicated [26]. The importance given to the order of placing of authors in publications is crucial in many areas of research, especially science, engineering, and technology [27,28], although author order concerns are not unique to the sciences [29].

The future success of your career path may depend on, or at least be significantly influenced by, your authorship placement on your first half dozen publications. If you undertake a research collaboration involving more people, then you may become the fourth author on a six - author paper. In national and international assessment exercises such as the REF, ERA, and New Zealand Performance Based Research Fund, the placing of authors in a list of those contributing to a publication is given very strong consideration. Similarly, author order is given very serious weight when you apply for research grant funding in your own right. It is difficult to claim accurately and legitimately that the bulk of the research in a publication is yours if you are in the middle of six authors.

The decision you need to make, and be satisfied with, is whether to try to maintain your high profile in a small group or play a lesser role in a larger research collaboration. Obviously if you are approached to collaborate because of your skills and expertise, then the potential for you to be the first author in the publications of a much larger group should be considered and will be much more worthwhile for you.

However, whatever you do with respect to research collaboration, it is essential that such things as authorship, ownership of intellectual property, presentation at conferences, etc. are established and agreed upon *before* the work commences. While this might sound overly officious and you may be worried that your international high profile collaborators may not be happy with such detailed arrangements, I believe that productive research

collaborators will appreciate the fact that you are just ensuring, as much as possible, that the research productivity of the collaboration is going to be optimal for all involved.

If you are an ECR employed as a postdoctoral fellow or in a commercial industry organisation, you will need approval and advice from your research supervisor or industry team leader before either approaching a potential research collaborator or agreeing to work with one that has approached you. What role, if any, will your supervisor play in the collaboration? Is your supervisor and organisation happy for you to provide potentially very academically or financially valuable information to people outside your organisation? What sort of official paperwork, such as a Materials Transfer Agreement or Confidentiality Agreement, does your organisation require before you can pursue research collaboration?

In addition, if you are approached to participate in a research collaboration then you should apply the issues raised earlier regarding seeking a supervisor with respect to selecting potential collaborators. What is their background? How do they carry out their research processes and will it be beneficial, or even possible for you to work collaboratively with them?

Many research collaborations are extremely productive for all involved and last for extended periods. Other collaborations may be of a more defined nature with shorter timeframes and involve the donation of laboratory reagents or translation of social texts. Healthy productive research collaborations may wax and wane, so whatever collaboration you enter into during your research career, it is essential that you have strategically thought through the overall benefits to your career.

Networking on the other hand is something that usually lasts much longer and is much less tangible, but it is also essential for your career.

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6

Networking

I don't think it's possible to overestimate the value of a productive and worthwhile network to an ECR. I have mentioned four major network participants already, your Ph.D. supervisor, your research supervisor, collaborators, and your mentor. There are also many others who you will benefit from and you will give value to, by being part of your network.

It is important to establish a strong and worthy network early, as it will certainly assist your research career. It is not important to have a very large network, as a few stronger and perhaps smaller networks will be much more beneficial than several weak or a large ineffective one. In addition to the four categories of people mentioned above, members of your network may include Ph.D. students you have worked with while completing your thesis, your Ph.D. examiners, members of professional societies, fellow conference attendees, people in your immediate research teams or in your wider organisation, your organisation's library staff, or the journal editors you may send papers to on a continuing basis. In short, it can be anyone who is significantly interested in or can be of benefit to your research career.

While this guide is all about strategic planning, often networks cannot be and are not planned. When the opportunity arises, I suggest you consider with whom you wish to network. There are a number of tools available such as LinkedIn, Facebook, and 2collab to facilitate the process. Usually, a network evolves naturally over time as your mentor, research supervisor, and collaborators introduce you to other potential network members. People who may become part of your network may approach you for any number of reasons.

Depending on their position, they may be of significant benefit to you now or later in your career. For example, you may need tangible direct assistance such as references for another position or a Fellowship and your network can be of great value by "singing the praises of you and your work" to others. There is certainly nothing like establishing the high quality of your international research by publishing in the most prestigious journals and presenting at the highest - level conferences. But it can take time to reach these achievements, so even then the impact of having others spread the word about how good you and your research are, cannot be understated. This is not a bad thing and will certainly facilitate your research career.

I would not like to give the impression that the only reason for establishing a strong network is to benefit your own career, although this should naturally be one of the major outcomes of being part of a network. You have skills, advice, and expertise to contribute to others in your network and as you advance and mature in your research career, you will be able to provide more input to others. Networking should be a fair give and take process. In the earlier stages of your research career you may need to take more than you give, but this will probably be reversed as your career progresses. So it all evens out and is quite fair and reasonable in the end.

7

Ethics

The giving and taking of research expertise and skills as part of your network over time could be seen as a reasonable approach to research ethics. Research ethics are an essential part of your career and one that I will not dwell on greatly here because maintaining the highest standards of ethics are a given. The research you carry out must be honest, accurate, and ethical.

In addition to what I have termed research ethics, there are several other facets to ethics, which you may need to consider during your research career. I will term these animal, human, and bio/radiological ethics.

There have been enormous advances in animal ethics over the last few years and a policy of "Reduce, Replace and Refine" is one that is widely used and promoted. It is not the role of this guide to comment on the use of animals in research. However, if you and your fellow researchers have determined that the appropriate use of animals is critical to your research, then it is absolutely essential that you follow your organisation's rules and policies. Research must never start until your organisation's animal ethics committee has accepted and approved it. This is despite the fact that there is often a very large amount of paperwork to do in order to receive ethics approval. It is essential that this is done, not only to ensure minimal or no adverse effects for the animals, but also that you stay within the legal requirements for such research.

Animal ethics committees often require voluminous amounts of documentation and this should be seen as what it is, necessary planning to ensure that the project to be carried out is appropriate. The animal ethics committee is not there to get in your way, but to almost act as a broker for you and your research, ensuring the best for the animals and for you.

Similarly, human ethics committees have become a very essential part of not only biological and medical research, but also much social science research. It is essential that the rights and privacy of all human participants in any research you may carry out are protected and your organisation's human ethics committee will assist you in ensuring that this happens. Even procedures as potentially innocuous as telephone interviews may have a significant impact on human ethics and thus they require approval.

The last facet of ethics I will discuss is what I call the bio/radiological aspects. While it may only apply to a very small percentage of researchers, this is extremely important and these days it even attracts security oversight. It is therefore necessary, once again, that before you even think about commencing any research in these areas, you have the approval of your organisation's appropriate committees, which may involve them requiring national approval.

While the approach to these different facets of ethics may have different emphases from country to country, with some countries focusing more on one or two components than other countries, you must conform to the rules and regulations applicable to your organisation at the time.

Should a question ever arise about any aspect of your research, your animal, human, or bio/radiological ethics committee(s), which have approved your research, may well become your best friend. It is up to you to ensure that you have their approval and that your research conforms to what they have approved.

This is the right thing to do for many ethical and social reasons and it makes good sense to plan and carry out your research in this way.

8

Choosing Your Publication's Style and Format

You should never undertake a piece of research just to have it published in a particular format, but there is much to be said for identifying a format for publication of the research output early on or even before the work begins.

Publication of your research is essential, whichever format you choose. If you do not publish your research outcomes, no one will ever know of its existence. Producing publications is not easy and it is not in fact research, but it is essential to your research effort, as future grants, promotions, and other job opportunities will depend upon the substantial high - quality research output documented in your CV. Unless you have documentation of the acceptance of your research outputs by your peers, then you will be unable to prove to potential grant funders, promotion panels, or new employers just how good your research output is or whether you have been productive at all.

Each major research discipline group is usually identified more with a particular format for publication. Humanities and social science researchers tend to focus on books or other monographs. Science, engineering and technology researchers focus on publishing in journals. Computing science and information technology researchers see electronic publication or conference presentation as being important formats in which to publish their research. Performance artists such as musicians, painters, and sculptors have their pieces of art as their publication, but even then it should be documented in some format such as the exhibitions where it is presented or other permanently documented ways to identify the impact of the research behind the work.

The next section will describe in more detail the factors you need to consider when publishing your research in journals, but in this section I am urging you to consider style and format. For example, whether it is a book, monograph, journal, electronic publication, or a conference presentation, will you publish in English or in your own national language? English is becoming much more readily accepted as the international language of research publication and the disadvantages of publishing in languages other than English are well known [30;31;32;33]. However, there may be reasons why you wish to have your research recognised by your national peers, which may require you to publish in your own language in a local format.

There are advantages and disadvantages in publishing in international formats in English compared with national formats in your own language. It may be that sometimes you publish in an international English format and other times in a national local language format. Often you might begin your research career by publishing in local language national formats and expanding to international publications in English later when your career has evolved. The decision is yours, informed by your research supervisor, colleagues in each piece of research, and possibly your mentor.

Parallel to your decision to try to publish locally or internationally is whether to publish with an international publisher of journals and books or with a local; potentially lesser - known publisher. These sorts of decisions are often based on the quality of the work you have done and on your research discipline area. However, a major question in publishing your research outcomes is whether to try to publish a small amount of possibly lower impact work sooner (see below regarding the Least Publishable Unit [LPU]) or whether you carry out additional research so that you can publish a higher impact study later.

There are numerous advantages and disadvantages to both of these options and you may alternate between these strategies depending on the circumstances prevailing at the time. Are you trying to complete and publish some work before submission of your Ph.D. or before the end of your current post - doc? Are your research colleagues and supervisor suggesting that you complete additional work before publishing? Does your mentor believe that you should spend time writing a book rather than trying to publish a few journal articles? It is up to you to decide how you commit your most valuable resources, your time and effort.

In many of the workshops I give to ECRs, I am often asked the question, ***"should I aim for quality or quantity in my publications?"*** My answer is always the same. Yes, you should aim for lots of good quality publications. Ideally your research career should be producing a large number of high quality publications. Clearly this is not easy and takes a substantial amount of hard work. As suggested above, you may be forced to consider an LPU (a publication that contains the minimal amount of research to just be accepted by an internationally refereed journal), or worse, a "salami" - like publication ("salami" publications are those where a piece of research is "sliced up" to give a larger number of publications whereas a smaller number of higher

quality publications would be possible [34]). Consider these for only real and justified reasons. In other cases, you may be able to publish your work from an extended very large high profile research project. It's all up to you, however as your current long - distance, remote mentor, I should point out that the current REF and ERA - type assessments tend to focus on an identified small number of your publications in order to assess your productivity. This practice, which is also often used by appointment or promotion panels, is likely to easily identify the chronic production of "salami" publications [35].

Consequently, my strong advice to you is to always aim for quality wherever possible if you have to make a choice between the quality and quantity. One can often measure the high profile of a research group by the work that they choose not to publish (e.g. LPUs and "salami" publications), rather than the work that they do publish. Quality is always of prime importance and it is being focused on more and more. Although the definition of quality is open to debate, there are increasing attempts to rank various types of publications. For example, in information and computing technology areas, the Computing Research and Education Association of Australasia (CORE) [36], an association of university departments of computer science in Australia and New Zealand, has a five tier ranking of about 1,000 information and communication technology conferences in 2007. Humanities researchers are planning to rank book - form publications and non - traditional publication formats for 15 areas of humanities as part of the European Reference Index for the Humanities (ERIH) project initially jointly sponsored by the European Science Foundation and the European Commission [37].

Having taken all these points on different publication formats into consideration, journal publication is certainly the most recognised format. To which journal should you submit your high profile research outputs for publication?

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9

Where to Publish

Having made the decision to publish your research outputs in an internationally peer - reviewed English - language journal, there are a number of factors that you should consider before even starting to write a paper for submission.

Perhaps one of your major decisions is whether to send your paper to an open access journal or one published by a traditional subscription - based publisher. Open access journals have become very popular over the last few years, especially with the advent and global spread of the World Wide Web. They offer the advantage of relatively easy access to potential readers for free. This has gained the support of a number of international funding agencies, which have mandated or at least recommend that you make all publications arising from work funded by them available in an open format. Such papers are accessed more than papers published in traditional journals, but it is possible that some authors submit their most popular articles for online presentation [38]. Also, although open access publishing may reach more readers, there is no evidence to suggest that they are more highly selected for citation than subscription access publishing [39;40]. Another potential disadvantage is that you will be responsible for paying for open access publication, which would be a charge to your personal research funding. In addition, some subscription publishers are now making their publications open after a period of time or are providing other services to allow free access [41]. However, whether you choose open access or subscription publishing, there are a number of factors common to both types that you need to consider before beginning your paper.

Although a number of countries, including South Korea, China, and Pakistan, pay their researchers to publish in high profile international journals [42;43], the receipt of funding should never be a reason for choosing a journal in which to publish. Of course, there are many valid and worthwhile reasons for publishing your research outputs in the best possible journals.

It has been suggested that in science, engineering, and technology areas, the journal's prestige and the makeup of the readership are usually of prime concern [44], although these characteristics may be of less importance in social science journals covering education than characteristics such as "clarity/coherence/well written", "thoroughness", "research method" and "appropriateness to Journal" [45]. My focus in this guide is to encourage you to aim for quality outputs, but how do you identify prestigious journals in which to publish your research?

There is no doubt that since 1955 when he first described its use, Garfield's impact factor has gained international recognition. Journals identify their prestigious nature and quality by their ranking according to journal impact factor not only in science, engineering, and technology, but also in social sciences and the humanities. Impact factor does have many uses, but it also consistently attracts criticism and Garfield often highlighted the potential for its misuse (for example see [46]).

With the recent announcement of and request for consultation on the assessment and funding of higher education research post the 2008 British RAE [47;48], making greater use of quantitative information "metrics" has led to a series of criticisms regarding the use of metrics alone to measure quality [49;50;51;52].

I strongly recommend the appropriate consideration of a journal's impact factor when making your selections, but the potential disadvantages of the impact factor have led to the invention of a number of other ways to measure the quality and prestigious nature of a journal. Although there is neither space here, nor is it the aim of this guide to give a detailed description and comparison of other ways to measure journal quality, you do need to be aware of the options that can be used to confirm the status of the journals in which you publish the outcomes of your research.

For example, the ERIH mentioned in the previous section has already established expert panels, which have ranked journals in 14 sub - disciplines of the humanities such as anthropology, gender studies, philosophy, and psychology based on three tiers. The lists are not bibliometric tools. The ERIH steering committee and the expert panels advise against using the lists as the only basis for assessment for promotion, for appointment, or for application for research grants [53]. Perhaps not surprisingly, the ERIH criteria have been criticised [54], however the rankings are public and the subject of continual evolution. I believe that the ESF should be applauded for this initiative to at least open debate on other ways of ranking humanities journals other than impact factor.

Similarly, there have also been attempts within the business and economics communities to rank journals using a

range of indicators to establish their quality and prestige. For example, the Aston University Business School in Birmingham has ranked about 800 journals into three key groups after evaluation by senior academic staff and other international business schools [55]. The Business Academic Research Directors Network (BARDsNET), jointly sponsored by the Australian Business Deans Council and the Australia and New Zealand Academy of Management, has ranked about 2,000 journals in 11 sub - discipline groups such as accounting and finance, marketing and market research, and economics into four levels [56]. Several research groups in economics have also developed journal - ranking systems using a range of alternative criteria [57;58]. CORE has not only ranked ICT conferences as described in the previous section, but they have also ranked about 800 journals [59] in the area of their membership according to four tiers. Although not an exact match, this four tier ranking has also been chosen by the ARC as a way of ranking journals across all areas of research for their ERA exercise.

The ARC commenced consultation for the ERA by distributing a draft list of 19,500 unique peer - reviewed journals and sought comment on the draft rankings from the research sector between June and August 2008. The ARC believes that a journal's quality rating represents the overall quality of the journal defined in terms of how it compares with other journals and should not be confused with its relevance or importance to a particular discipline.

As of June 2009, a ranking of over 1,400 journals in physics, chemistry, and earth sciences (PCE), along with over 6,700 journals in humanities and creative arts (HCA) are listed on the ARC's website [60]. The PCE journal list identifies the journals that are indexed by Scopus and are therefore subject to citation analysis under ERA, with the HCA cluster not using citation analysis and therefore not containing indexing information.

The Scopus Journal Analyzer [61] enables you to search for journals within a specific field, identify which are the most influential, and find out who publishes them. This will help you to decide where to publish to get the best visibility for your work and how to prioritise your submissions. The data is updated every two months so you can see where the journals stand now, not last year.

Hence, there are a number of internationally available journal ranking systems for all research disciplines that you should seriously consider using, perhaps in addition to or instead of impact factor, to highlight the quality of the journals where you publish the outputs of your research.

Of course, these systems all rank the quality of the journal in which you have published and it is assumed that top quality journals publish top quality papers. It is possible however, that even top quality journals publish papers that are individually not highly cited, and conversely, journals that are not necessarily considered top quality by ranking systems may publish papers that are very highly cited. Although these situations may be relatively rare, if your paper receives numerous citations then another perhaps even more specific measure of the outstanding nature of your research outputs is to quote appropriate statistics on the citations received by your papers. There are a number of email alerting systems, such as Scopus, available on the web that will notify you of papers that cite your papers. You should certainly avail yourself of these services and document the notifications on your CV.

The increasing use of the World Wide Web is also leading to the wider use of the web for the quantitative study of web - related phenomena. This is based on the realisation that methods originally used for bibliometric analysis of citation patterns to journal articles can be applied to the web using commercially available search engines providing the raw data. This relatively recent, more electronic - based journal ranking has been termed "webometrics" [62;63].
Even more recently, a new open access Internet database lets users calculate a paper's impact factor using a new algorithm similar to page rank, which is the algorithm Google uses to rank web pages. This SCImago Journal Rank analyses the citation links between journals in a series of iterative cycles using a citation window of three years [64].

Clearly, ranking journals using a range of diverse analyses and tools to define their quality is here to stay and such use is likely to increase with time. I strongly recommend that you use all available appropriate resources to validate the high quality and impact of your research outputs to your peers.

Although the quality of the journal should be a prime consideration, there are certainly other factors that you should weigh up before submitting your paper. What is the speed of acceptance for papers in the journal? Is the area of your research similar to that which the journal normally publishes? Perhaps most importantly, is the quality of your

research really at the level that is typically published in the journal? Certainly we would all like to publish in only the top two or three journals in our discipline, but if for whatever reason you have decided to publish this particular piece of research, is it really at the level of the top three journals in your field? What does your research supervisor think? What does your mentor say? An honest accurate appraisal of the level of the research outputs you intend to publish now may save a lot of time and anguish later because the work is either inappropriate for, or not at the level of, papers normally published by the journal. Although I recommend that you aim to produce the best possible research, your choice of the journals you submit to must be realistic.

The range of factors that identify a good paper worth publishing does vary from field to field. The science, engineering, and technology areas may focus on the journal's prestige and the makeup of the journal's readership, but the innovative and novel nature of the work should ideally be highlighted for all discipline areas.

The outputs should clearly be the result of the excellent planning and design you undertook before commencing the research, but having identified a journal you wish to submit to, what do you now need to focus on with respect to writing your paper?

The major issue in submitting a paper to a journal for publication is to first read, understand, and comply with the instructions to authors. This is essential to ensure the most efficient processing and reviewing of your paper and should be done before you start drafting it. I then recommend that you start from the title and abstract and write a complete, even if rough, draft of the paper. Having the core of the paper outlined, even in dot points, facilitates the writing process. Making a complete draft avoids getting stuck on a point that prevents or delays documenting the rest of the paper. Often you might move sections of the introduction to the discussion and vice versa, so making each section perfect before you do the next section is usually inefficient.

At this stage it is probably also worth obtaining the input of a native English speaker if English is not your first language, as errors in grammar and proper expression (which are not especially easy for native English speakers) can hamper the review of your paper [65,66].

Your title, which is the main "publicity banner" for your paper, should contain the fewest possible words (ideally less than a dozen) that accurately describe the content. It should express only one idea or subject and start with a few important words. The increasing webometrics - type analyses mentioned above make it essential that your key words highlight the main content of the paper and can be easily understood, indexed, and retrieved by a database search.

The introduction should begin with a concise description of essential background to the problem, hypothesis, or area of scholarly activity being researched. You should then state the objective of the research and clearly establish the significance of your work, especially in relation to what was previously known about the area.

The methods section should always be accurate, described in sufficient detail to be able to be fully reproduced, and for quantitative studies, have well documented and appropriate statistical tests.

Results must be clear, statistically valid if appropriate, and presented in the manner required by the journal in the instructions to authors.

Organise your discussion to go from a specific focus to a general one and relate your findings to the research literature, to theories, and to practices in your research discipline. Restate the hypothesis you were testing or scholarly question being addressed and provide answers for questions asked in the introduction. Support your answers with accurate, clear, and validated results. Explain succinctly and clearly how your results relate to expectations and to the research literature on the topic. Discuss, evaluate, and offer plausible reasons for conflicting results. Discuss any unexpected findings and provide a few recommendations for further research, but do not over extrapolate or make claims that are not definitively confirmed by your results.

In summary, your paper should describe excellent (novel and innovative) research, be well described and not over extrapolated, with accurate statistics if appropriate, and follow a succinct logical progression convincing the reader of its quality. Abstract and key words are essential. Ideally begin by writing a comprehensive first draft.

A number of journal publications along these lines will certainly provide you with a good base for convincing funding agencies to assess your grant applications highly.

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Preparing a Grant Funding Application

The research you have done to date has been organised and funded by others. Your Ph.D. supervisor, your research team leader, or the head of the group in your company provides the funding for you to do your research. However, there will come a time, probably sooner if your research career is advancing at the rate at which it should be, when you will want to apply for research funding in your own right as a chief investigator.

Before you put pen to paper, or even consider applying for research funding, you need to ask yourself several questions and be satisfied with your answers, as research funding is generally very competitive and applying seriously can take a significant amount of your time.

You should certainly think about the planned research funding application in the whole context of your professional career, as you don't always need to get money to do your research. What is the relationship between your aspirations to do research and the availability of funding? Why are you applying for funding? Why do you need funding? What is the minimum amount you need to ensure the success of the research project you are asking to be funded? When you are satisfied with your answers to these questions and you understand that applying for research funding is a very major commitment, only then should you start to prepare your application.

It is essential that you must believe in the importance of the research you are proposing to do so that you can convince your peers of its importance. Until now I have talked about publishing work you have already done, but now you must convince your peers that it is worth entrusting you with significant amounts of funding, rather than giving it to another research group who will also be putting up a very convincing case.

If you do need money, where can you get it?

Most countries have national and some even have state research funding agencies. Some of these, such as the Deutsche Forschungsgemeinschaft (German Research Agency–DFG), Ministère de l'Enseignement Supérieur et de la Recherche (French Ministry of Higher Education and Research), and National Science Council of Taiwan, accept applications in all research disciplines. Others such as the Indian Council of Social Science Research, National Sciences and Engineering Research Council of Canada, the British Research Councils, the U.S. NSF, and National Institute of Health focus on specific research disciplines.

Their websites and public portals to their programs are very comprehensive and easily accessible. There are also a number of websites that provide comprehensive information on grant applications for multiple funding agencies. There is a one - stop free resource to find funds for research and training in the sciences at GrantsNet [67]. Grants.gov [68] is a source to find and apply for U.S. federal government grants. Research.gov [69] and science.gov [70] provide information about research and development results associated with specific grants. Grants.gov does include information on NSF grants, but the NSF also has its own service [71] that will alert you via email with updates on projects and grants funded by the NSF as soon as they are announced. The DFG even has international representation in Beijing (Sino - German Center for Research Promotion), Moscow, Delhi, Washington, and now Tokyo. Elsevier recently launched its highly anticipated SciVal Funding [72] tool designed to mitigate the challenges you face when applying for funding and give you an edge over the competition.

There are also funding agencies that foster multi - country research programs, perhaps the largest one being the European Union's programs and another being the Human Frontier Science Program (HFSP) [73], which promotes world - scale research in the life sciences through research grants, fellowships, and workshops. HFSP grants are awarded for novel collaborations involving extensive collaboration among teams of scientists working in different countries and in different disciplines.

But do you really need that much money? In the early stages of your research career, perhaps a smaller budget request that could be funded internally by your own host organisation may be an appropriate way to go, allowing you to build up to some of the more prestigious and much larger national or international research funding schemes later. This is one of the important questions that you need to answer before commencing an application, as mentioned above.

But be it a small internal research application or a mega application to an international funding agency, there are certain principles and procedures that you must follow in order to ensure your application is as competitive as possible.

Having decided that you are going to apply for funding, you should first undertake an exercise where you write down a 100 - word summary of your proposal and show it to your research supervisor and mentor and talk about it with them. What is the research aim of your three - year project? What will you deliver at the end of this project? It is important to be realistic here and not overstate what you and your co - investigators can actually do during the period of the research funding. While it is important to be productive for the funding being sought, grossly overstating the outcomes will not make your application more competitive. Similarly, you need to decide whether it will be just you applying alone as chief investigator or whether you will need co - chief investigators in order to justify to the grant funding agency that the relevant skills and expertise to ensure the success of the project exist among the applicants.

In funding schemes where the track records of the chief investigators are very important, you should seriously consider whether your track record shows sufficient quality and quantity to justify the time you will commit to this application or whether you should wait to build up your track record before applying. Your supervisor and mentor can advise here. If you do decide to proceed, do you need co - chief investigators who have track records that can "lift" yours? If so, then it is always a good idea to have worked previously with these co - applicants, and ideally, published with them before. This will show that this is a longer term relationship, not one that has only come together to "get some money" and the more senior researchers may not contribute much to the project once the application is funded.

Having done all this you then need to decide which funding agency you will approach. Ensure that the aim of your application is consistent with the agency's goals and objectives. There is little point in applying for funding from an agency that does not see the type of research you are proposing as an important focus for its funds. This sort of information is usually detailed in the description for the funding agency, but it is also a good idea to look at the topics and summaries of successful applications funded by that agency over the last few years. What type of research does that funding agency promote? Rather than searching each agency's site, you can access this information online through the SciVal Funding site.

It is now essential that you read and understand all of the information put out by the funding agency on the scheme for which you are about to apply. Perhaps the most important point to ascertain is the closing date for the next round of applications. Competition is so great for most national and international agency funds that unfortunately they are just not waiting for your application. They receive many more applications than they can possibly fund and those applications will conform to the agency's rules and regulations and be submitted before the closing date. To be competitive, yours must as well!

When beginning to write the application it is a very good idea to keep the assessment criteria for this particular funding scheme in mind. What percentage of the selection is based on the applicants' track records? How important is the novelty of the idea? How many pages do you have available to describe the approach and methods? Does this funding scheme focus on "blue sky" research or is it much more applied with an industry partner being involved? These are all important policy considerations in making your application as competitive as possible.

There are also a number of more administrative or specific points that identify a good quality application. You should:

- Highlight your strong, promising track records
- Present problems and/or controversies and explain how you will solve them, rather than a collection of data
- Explain how the momentum of the subject demands funding now
- Show how your work fits in to the current international picture (don't describe "backwater" research without momentum)
- Back up compelling claims with evidence and judgments by others
- Carefully temper ambitious goals with plausible approaches
- Display evidence of responsible, but often daring approaches to the problem
- Not make grandiose and implausible claims about outcomes
- Ensure that the outcomes you describe are really achievable within the term of the grant
- Show you are involved in national and international research networks
- Avoid the use of excessive technical jargon
- Have no spelling or grammatical errors or unedited nonsense in the text
- Present excellent progress reports on previous grants (if applicable)

Following the strategy and guidelines described above will certainly improve the competitiveness of your research funding application and a funded application will certainly add to the profile and continuing evolution of your research career.

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Collaborating with Industry and Academia

Unlike the rest of this guide, which is written to give tips and advice to ECRs no matter which type of organisation you work for, this section is divided into two components. One is for ECRs who work in universities, medical research institutes, or government research institutes (for ease of discussion here now termed academia). The other is for those who work in commercial or industrial companies.

If you work in academia, then there are a number of reasons why you might consider forming collaborations with industry and industry partners. While there is much to be said for carrying out "blue sky" basic or fundamental research, these days and probably even more so in the future, governments are finding it increasingly difficult to fund such work and there is an international focus on leveraging your results towards commercial outcomes. The Japanese government's series of sangaku renkei (university - industry collaboration) in the mid - 1990s and the Finnish government's more recent efforts to encourage university - industry collaboration certainly appear to have been worthwhile [74,75].

In addition to potentially adding to your country's wealth, this sort of activity brings a number of benefits to you personally should you pursue it. The production of patents and licenses and involvement in setting up commercial spin - off companies can provide ECRs working in academia not only funding to employ staff and carry out further research, but also a significant personal financial gain if your organisation's policies allow it. However, these positive outcomes are not without disadvantages. The commercial secrecy surrounding such activity can lead to delays in carrying out the research, increased paperwork for commercial transfer agreements, and perhaps most significantly of all, delays in submitting your work for publication because of the necessity to keep it confidential during the patent application process.

But similar to all the other aspects of your career described in this guide, if you make a strategic decision to collaborate or work more closely with industry, you need to know how to go about it. The establishment of a strong long - term relationship with an industry partner can take a great amount of effort and time. So, how do you identify a project and a partner? There are three major routes for this:

1. You have a research idea and seek a partner that will be interested in supporting this research. This approach requires significant time and effort from you or possibly staff in your organisation's Business Development Office or Commercialisation and Technology Transfer Office. You need to identify a potential partner who would be prepared to work with you because your research will add value to their desired commercial outcomes.

2. You know a potential partner (through networks) and ask if there is research that they want to undertake, but are constrained (for whatever reason) to do. This approach is one that could arise from your established networks and is perhaps more of a "known" approach than the "cold" approach. This is more likely to be successful in a shorter period because the industry partner knows you, or at least knows of you, via your research networks and emphasises again the importance of having a good research network.

3. The potential partner is already doing something and you can add value. Because of your networks and good reputation in this area, possibly through high profile publication of your basic fundamental research, the potential partner approaches you to assist them with their research. Also, most universities and many medical research institutes and government funded research organisations have areas on their websites where staff list their commercial expertise and potential availability to work with commercial and industrial partners in various research sub - disciplines.

Naturally, each of these approaches may be used in various projects you may undertake with industry and while these cover the broad spectrum of possibilities, there is naturally the potential for a relationship to develop based on a compromise of these activities. Whichever way your relationships with industry develop, you should ensure as much as possible that all collaborators, including your academic colleagues, but especially the industrial and commercial partners, benefit from this mutually symbiotic and ideally synergistic relationship. Such partnerships can assist your research career enormously, but as suggested above, they are not without potential disadvantages that you should be aware of and accept before pursuing such commercial industrial relationships.

If you are employed by and therefore carrying out research for a commercial industrial company, there is also a range of very positive potential outcomes, but some significant potential disadvantages, in participating in university - industry relationships. At the personal level, the expanded academic

input may lead to you becoming much more widely published in academic outputs, and many universities have the ability and in fact want to, confer honorary academic positions on their long - standing highly regarded industrial partners. If you are working in a commercial company, your appointment as an affiliate associate or full professor by a major research university provides you a personal cachet and academic recognition that would not be possible working exclusively within your commercial environment. This is likely to lead to a promotion within your organisation and also offers the possibility of periods or a permanent place in academia at a later stage. Commercial and industrial companies often value staff such as yourself being given honorary academic appointments and being involved in university research projects because it shows that your company is regarded by the academic community and is seen as one worth working with.

Unfortunately, working with academics is not without disadvantage as they often, because of constraints such as teaching and administration obligations, carry out research at a pace slower than commercial companies or industry would like. Their goals and aims in the research are often more academically focused than industrially or commercially focused. However, through establishing a mutual respect and a shared commitment to the mutually synergistic success of the joint project, then the development of a strong long - term relationship has very positive aspects for all involved and should be highly sought after and pursued.

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12

Attending Conferences

Congratulations again. You have just won an all expenses paid week - long holiday in Hawaii, New York, the Italian Riviera, or the Australian Great Barrier Reef. Now, clearly the week in some exotic location has been chosen for a conference that will bring together key researchers at either a national or international level. Your organisation has nominated you to attend or you have some budget allocated that will allow you to attend. This should always be seen as a privilege, not a right, and you should get maximum benefit out of it.

Before packing your luggage, you need to ask yourself some questions. Why do I need to attend? Will I really get something out of it? Could I use the time more efficiently at work? What will I add to my research career by taking this week or two off flying halfway around the world and interrupting my research workflow?

These are important questions because conference attendance in the early stages of your career is not something that is common and happens often to everyone. You should decide that if you are going to attend a conference, you should get the maximum value out of it. And just being at the conference is not necessarily a positive for your career; it will take a lot of hard work to ensure that. So if you do decide to attend, you need to plan well.

Clearly, there are many types of conferences and what you can get out of them will vary greatly on what the individual conference is and what it has to offer. But this is precisely what you must look at and consider. Early in my research career I was fortunate enough to be invited to attend a conference of less than 20 people in a New Hampshire ski chalet. Many years later as a senior university research leader, I attended a more generalist conference along with over 10,000 other people. There is no doubt that I achieved much more at the small boutique conference with regard to my own personal research career than I ever could have by being surrounded by thousands of other attendees who often filled the lecture rooms to overflowing. But I went to the latter conference wanting to achieve very different goals than the ones I had held many years earlier.

Now with proper planning you can certainly make attending a conference more worthwhile, but you need to weigh up the advantages and disadvantages of attending. What will you contribute to the conference and what will you get out of it?

While there may be benefit in attending a conference without presenting, there is always added value in presenting a worthwhile, up-to-date and exciting talk on your research. But are you really ready to attend? Will you be giving away any “hot” new results from your latest research that will prevent you from applying for patents and potentially give your competitors a very significant edge in publication just to impress the audience? Alternatively, are you just going to restate work you have already published and that will be less interesting to your audience in order to avoid the patenting and publishing problems? Or will you be in a position to give a review of your work, the work of your research team, or perhaps also include the work of others?

To some extent, what you can present depends on whether you are invited to participate in a symposium where a review/overview talk might be appropriate or whether you are submitting your work for presentation that would need to be specifically and recently focused. Will you be content with presenting a poster if your presentation is deemed to be more suited to that format? If you attend the conference, you need to make sure that you leave a lasting positive impression on your audience so that others may talk with you and about you and your work. You need to impress them and make sure that you are invited back. If you are unable to do this well at the present time, you should consider skipping this one and attending the next one when you are better prepared.

It is important that you are selective about which conferences you attend and what you present. I have been on a number of promotion panels and while conference attendance can be the major format of presentation for some research sub - disciplines, in most cases applicants who have three times or more conference presentations than published papers, books, or chapters are often perceived as spending more time on holidays than actually doing work. Hence if you are going to go to a conference and present your new work, it must certainly be followed up shortly after with a publication in either a journal or other written refereed form.

Perhaps the most important reason for going to a conference is the networking opportunity it can provide. This can be either at the conference through discussions with other attending researchers or with researchers who you may visit on your way to the conference. As with your research career, strategic planning and early thought will pay dividends. Conferences are usually advertised at least a year in advance so you

should determine where you might make a stopover on the way. This will allow you to meet potential new collaborators or catch up with existing colleagues thereby expanding or strengthening your networks.

Read the conference program as soon as it appears on the web or when it is available in hard copy. This way you can determine who will be presenting their work and perhaps arrange to meet them at the conference. It can be difficult to meet a person even with a prior arrangement at a conference with 10,000 attendees. In addition, early review of the program will allow you to determine which presentations you will listen to and thereby allow you to plan your meeting schedule.

There is no doubt that conference attendance is an excellent way to increase your network with national and international researchers, depending on the type of the conference. But obviously this must be done appropriately and with as much planning as possible. Do you need someone you know at the conference to introduce you to one of the keynote speakers or will you be able to meet and introduce yourself directly without seeming brusque or inconsiderate?

If you do decide to present the results of your work, then you must conform to the rules of abstract submission both in style and length, but also within the timeline requested. Having decided to attend, you must register and ensure payment is received before the due date or decide to register at the conference if that option is available, although it is usually more expensive.

I have assumed that your organisation is paying for your attendance at the conference. However, should your career be at such a stage that you are invited by the organisers to participate and they fund part or all of your attendance fees, then naturally your input should be the highest quality and quantity possible in order to justify their confidence of investing in you.

Having highlighted the importance of putting significant effort into your conference attendance to ensure that your presentation and participation is highly regarded by the other attendees and is also of benefit to you, you should take the opportunity during program breaks to take in some of the culture of the country you are visiting. Perhaps later you may be approached by students from that nation to work with you or even be offered a position in that country, so if you are at least briefly familiar with the country, you will be better equipped to make informed decisions on what to do. International travel can be tiring, especially if you make a stopover on the way, so try to arrive at the conference venue a day or two early to overcome jetlag and engage in a little acculturation. Your participation in the conference will be better for at least feeling like you're in the same time zone in which you're presenting.

Your participation should not end when you board the plane or train to return home. You should consider keeping notes on the discussions you've had with senior researchers attending and take the opportunity to follow up the initial discussions by email or other correspondence. If you are the only person attending from your organisation, you should prepare a brief written report on the conference describing what you got out of it. This will not only justify your attendance to your colleagues and highlight the worth of having sent you, but also give guidance to others who may consider attending that conference the next time it is held.

These follow - ups add to your network both locally and internationally and certainly assist the advancement of your research career. Most conferences are organised or fostered by a society. Are you a member? If not, why?

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Society Memberships

There are many advantages to being a member of a society and I strongly recommend that you consider them. Possibly the only disadvantages are that being a member of too many societies can mean a large financial cost to join them all and a CV is not enhanced by a long list of society memberships.

Perhaps the first society you join will be an unofficial one, but it's possibly the most important. Attendance at the weekly or fortnightly research group presentation of your organisation's department or your discipline is essential for many reasons. Participating in this "society" not only allows you to learn and hear about the latest research results of your colleagues, but also of the areas in which they are working. Your presentations at this "society" also expand your network and build your reputation in the eyes of your colleagues and local peers. Applications for promotion or internal funding are often facilitated by your participation and long - term commitment to the local "society." Often a senior ECR may be asked to organise the meetings and if your department has a travel budget, you can invite speakers from other cities or countries who you may eventually add to your research network.

There are also many national and international official societies. They are all important and many provide very significant advantages to your career, but you must be selective about which ones you join.

National societies generally hold an annual conference that brings the people working in your country together. They often have national prizes and many sponsor a national or international journal. Some have professional - type exams or assessments that identify you as a professional in that discipline. Society membership lists are promulgated, which allows you to find out who in your country is working on what aspects of research. Attendance and participation in these societies can have long - term benefits and the award of one of their research prizes can certainly boost your research career.

International societies are also very important and obviously work at a much more global level than national societies. They also hold international conferences and many publish their own journals that have advantages similar to those mentioned above for national societies, but on a global scale. The award of prizes from these societies and other activities, such as invitations to present keynote papers at the international society meeting, are indicators of the high level of your research activity and will certainly benefit your research career.

Up to this point, I have concentrated on you being an active researcher who participates in the society as an ordinary member. However, should you wish to expedite the formation of your network, get more nationally or internationally known, or do something to help your research discipline and its society from an altruistic standpoint, you might consider running for election to be a society office bearer. This should be done only after serious consideration because if you are going to be an office bearer then you must perform well in order to highlight your research capability and organisational capacity. Accepting the position and not doing a proficient job is not good advertising for your research career. However, despite the hard work that is required for these roles, the networking opportunities, praise, and acknowledgement you will receive for a job well done can make the effort put forth very worthwhile. Like everything else described in this guide, it is a matter of strategically planning what part you wish to play in the society and committing the appropriate time and effort.

Regardless of the role you take in these societies, you must aim to do the best job possible. And if you do wish to stand as an office bearer and represent the members of a society in an official capacity, then it is a good idea to be able to appropriately sell your accomplishments.

14

Selling Your Accomplishments

There is never any substitute for a long list of high quality research outputs, but in today's competitive international environment, it may not be sufficient to just have the outputs. One must be able to appropriately sell their achievements. However, there is nothing worse than someone who tries to sell achievements that are not at the level at which they are selling them. How do you determine the level of your achievements?

Clearly, your research supervisor, mentor, or other senior members of your network can give guidance and advice. In addition, there are a number of quantitative measures you can apply to assess and confirm your productivity's level of international competitiveness.

The potential problems with the impact factor were mentioned earlier and the eigenfactor [76] has been proposed as an alternative. This method ranks journals by measuring the importance of the citation by the influence of the citing journal and therefore puts more weight on the importance of the journal containing the citation than is measured using the impact factor. But despite this, the eigenfactor still only provides a measure of the journal containing your publications, not a specific measure of the quality of your publications.

Refereed international journal publications are now being increasingly assessed by your *h* index [77] and a variation of the *h* index termed the *m* index, which takes into account years since first publication and therefore is more attractive to an ECR. The importance of the use of parameters such as the *h* index, along with the fact that the *h* index itself has come under criticism, has led a number of groups to publish analyses defining potentially more useful indices, one of which has been termed the *g* index [78], another is described as a generalised *h* index [79], and another modified for self - citations is termed the sharpened *h* index (h_s) [80].

The most interesting aspect of a number of these citation index modifications is the fact that they can also be used to give reasonable comparisons of productivity across a broad range of science areas, from agriculture to mathematics to physics and tropical medicine [81,82,83,84,85]. There is not enough space here to go in to detail on the use and worth of these modifications of the *h* index, but it does show that there is much research being carried out on how to overcome the potential problems of such assessment formats. It is therefore highly likely that over the next few years, the *h* index, or its refined successors, will be even more widely used than they are now to assess quality. You should therefore take every opportunity to use these assessment formats to determine your level of quality over your research career. This will be mentioned later in following sections, but how do you make sure that you have maximised and appropriately sold your assessed quality outputs once you have established your research quality?

For example, if I go to your organisation's website and search for your name, will I be able to find accurate and up-to-date information on your productivity? Industries looking for academic collaborators with specific expertise often use your organisation's website to identify appropriate individuals and it is important that you are not only listed, but are listed accurately with the most current information.

The web is now an invaluable international resource and you must be listed not only appropriately and accurately, but also as widely as possible. Several studies focusing on legal scholars and information science researchers [86,87,88] found that high profile academics, at least in these discipline areas, were no more famous than famous non - academics when assessed using aggregated media mentions. This possibly suggests that even very high profile academics do not sell themselves sufficiently compared with the non - academic general population. However, what I do find interesting with these research projects is the formats in which the authors were able to make the comparisons of web mention. These varied from conference abstracts or conference proceedings to external home pages, listserv emails, syllabuses, and even newspaper and magazine files using the LexisNexis academic university news files for the previous five years. These studies were carried out before the very recent, almost exponential use of such web facilities as Facebook, so perhaps the web exposure of researchers, and especially young ECRs, may increase in future.

What these studies suggest is that perhaps all researchers should be more proactive in advertising their high quality outputs. You should certainly do it to ensure that your career expands and rises as quickly as it should from your hard work and high quality outputs. There are numerous ways to do this such as making sure you are represented on your organisation's website and taking every opportunity to describe your research outputs in newspapers, magazines, radio, TV, your society newsletters, professional magazines, etc. In fact, while I have been focusing on these formats as

areas to further improve your research profile, the altruistic way of looking at this is to suggest that if your research is funded by public money, then you have a duty to report your results to society in a number of these formats. We concentrate very much on publishing to inform and impress our research peers and perhaps we should also be focusing on reporting our results to the society that funds us? Such reporting would need to be in lay language that will clearly explain your research to people who are not familiar with your terminology, but it should always be accurate and honest. It will be worth your effort.

In this section, I have only emphasised selling your research achievements. However, now and certainly in the future with most national governments increasing their focus on the social, economic, and environmental (SEE) impacts of publicly funded research, you will need to bear these SEE impact achievements in mind as well. While publication of your research achievements - in the best possible journal that receives hundreds of citations - would be an outstanding achievement, nowadays governments are also asking researchers to show how society benefitted from that research.

The problem is that such SEE impact achievements are still not clearly defined or necessarily accepted, as they cover numerous potential outcomes and are difficult, though not impossible, to measure accurately. The major challenge with the widespread use of SEE impacts to measure the worth of research outcomes, is lack of agreement on what should be included and how thay can be accurately measured by sufficiently large numbers of researchers in each discipline, academic, or industrial group.

However, I have no doubt that in time both public pressure and the need to justify further public spending on research will make the use of such SEE impacts much more widespread and you should at least be aware of the variety of them that might impact your research.

For example, the Research Quality Framework (RQF) exercise that the then Australian Government was planning to carry out, contained many examples of possible SEE impacts and asked researchers to assess whether their research had been used:

- To generate new policies, products, processes, attitudes, behaviors, or outlooks
- To contribute to a policy outcome that has produced a measurably significant or outstanding benefit
- In public debate that has influenced public opinion
- For creation of spin - off companies, marketing, commercialising new products, technologies, or significant co - investment in commercialisation by investors or end - users
- In creation of processes that led to improved outcomes and productivity in industry or policy
- In creation of a new process, method, product, analysis, or theoretical tool, which becomes standard professional practice, resulting in measurable benefit
- To transform international perceptions of culture, as indicated by growing interests of international audiences, artists, and performing art industries leading to measurable benefit
- In historical research that has led to the preservation of media or other cultural artifacts
- For significant cost savings or has substantially raised productivity for industry or government
- To improve health outcomes through improved effectiveness and efficacy of a device, procedure, or drug as indicated by increases in well being, life - span, or survival ratio of patients
- To improve quality of care resulting from adoption of better clinical practice or procedures as indicated by decreased mortality or morbidity
- In new procedures and behaviors that have reduced treatment time and costs resulting in significant or outstanding benefit to society
- In relevant national or international legislation, legal judgments, committees of inquiry, or policy statements
- For teaching or training materials
- For collaborative community events, festivals, artworks, and social interventions
- As drama and applied theatre in educational, community, cultural, or social contexts

The newly elected Australian government terminated the RQF exercise when it came to power in late 2007, and I believe that the lack of agreement among Australian universities on SEE impacts significantly hastened the termination of the RQF.

This section of the guide started by saying that there is never any substitute for a long list of high quality research outputs. That certainly is true, but if you and others have used the research contained in that long list to improve SEE impacts as described above, then your research will be seen as even more worthwhile.

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Curriculum Vitae

When you do start attending conferences and expanding your network, you will probably give away business cards as an easy way of introducing yourself to new colleagues. In some countries, the proper presentation of your business card is almost a ritual. Your business card contains your contact information, but you should also have a much more detailed format prepared to inform others of your career highlights and success.

It is essential to have a CV that not only contains quality outcomes, but is also presented in a manner that publicises your outcomes in a clear and distinct manner. It must be accurate and up-to-date. While you must be selective about what goes into your public official CV, I strongly recommend you also have an unofficial version that contains records of everything you do. The talk you gave at another university last month, the newspaper item that featured your research group's outcomes last year, or the full details of last year's preliminary patent application are events that you will eventually need to accurately document. The only way to do this effectively is to record events at the time that they occur. This of course means that you have a very large amount of information that could be far too detailed for a public official CV. But having the information available in an unofficial format, which can then be transferred to sections of your official public CV when necessary, will ensure that your research outputs get the best judgment possible.

Your official CV must not only be accurate and up-to-date, but also it should be succinct, informative, and understandable to readers from a range of backgrounds and cultures. So avoid the use of abbreviations or at least explain them fully, use language that will be understandable to colleagues who may not use your language as their first language, and above all make it an honest CV. By this I mean in regard to such things as publications. There really are clear differences between a publication in an internationally refereed journal with an ISSN number and a proffered non - refereed presentation at a conference. Both have their worth and both are worth pursuing, but include headings that identify what each is so that it does not appear as though you are claiming that publications are at a different level than they actually are. Readers greatly value accuracy and clear definition over having to wade through pages of unclear material to try and determine the worth of a CV that spans 20 or 30 pages. In order to assist your readers, always provide evidence of claims and specific details wherever possible.

Your organisation may have a standard CV format to be used when applying for things such as internal promotion or grant applications. If so, then you should certainly use what is recommended or deemed essential. However, many organisations do not mandate CV styles so I have listed below example headings that you may consider for your CV. At present, you may not have information to include in each category, but over time you probably will generate career outputs in all of these categories. While a CV covers all aspects of your career including teaching, community service, administration and leadership, industrial productivity, and business activity, the headings depend on the type of organisation employing you. The CV example below is naturally more focused on research, as this is a guide about mentoring your research career.

Example CV Headings

i. Tertiary education
ii. Honors and awards
iii. Employment
iv. Current role and responsibilities
v. Academic committees
vi. Professional committees
vii. Teaching experience
viii. Theses examined
ix. Commercial/industry collaboration
x. Academic management/leadership courses attended
xi. Editorial responsibilities
xii. Referee for:
    1. Manuscripts
    2. Research grant applications
    3. Professorial promotions/appointments
xiii. Research grants received
xiv. Presentations at international meetings
xv. Presentations at national meetings
xvi. Publications
    1. Books
    2. Book chapters
    3. Refereed journals
    4. Refereed conference publications
    5. Publications in the lay press (newspapers, magazines) or scientific magazines
    6. Abstracts, letters to the editor, or conference proceedings

As mentioned in earlier sections, author order is very important. Such things as the order of the authors in publications, including perhaps your percentage input and your role in grant funding applications and research programs, are good things to list.

Naturally, the headings in the example CV above are not necessarily exhaustive and you or your organisation may have others to add. However, no matter what style or format you use for your CV, it is essential that you have one and that it is accurate, up-to-date and relatively easy to absorb by someone who wishes to determine the quality of your research career outputs.

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Applying for Fellowships

Whether you have a relatively new university academic appointment or are employed by a commercial research organisation, it is likely that you have a number of other responsibilities in addition to your research activities. While these other activities are important and indeed may be the reason that you receive a salary, they do require effort and expertise that you could be contributing to your research career. Postdoctoral fellows and researchers in medical research institutes may be able to focus more on just their research, but in any case there are many reasons for applying for a full - time research fellowship.

Full - time research experience in an environment other than your usual organisation adds greatly to your skills and expertise and allows you to focus as much as possible on on your research alone. Clearly there are many positives in receiving a fellowship to work in a research environment overseas. Not only will you pick up skills and expertise that may not be present in your own country, but you will also expand your network and list of international collaborators. Such experience in organisations overseas adds significant kudos to your research career that should place you in extremely good stead, should you return to your home country or decide to stay in the country where you have taken up the fellowship.

Because of the numerous advantages associated with being a fellowship holder, they are very competitive and you will need to work very hard to both apply for, and be awarded one. However, having followed the advice given in this guide, you should be well equipped for preparing your fellowship application. Your previous research supervisors, collaborators, and your mentor are ideal people to seek references from and you will have all necessary information available at your fingertips in your well - documented and up-to-date CV.

Some fellowships are associated with research projects in the proposed organisation and you will need to collaborate with the potential supervisor in order to apply. You will need details on a proposed research project that the new supervisor will be happy for you to carry out in their organisation. Some fellowships fund only your salary while others are much more comprehensive and include salary, travel, and research maintenance in the new location.

Fellowships such as the Churchill, Fulbright, Rhodes, and Von Humboldt are internationally known and they advertise widely for applications. You should certainly look out for these, as they are very prestigious and very worthwhile. Other fellowships are more locally focused and may allow you to carry out full - time research at organisations in your own country.

Some fellowships such as the ones listed above are partially or fully “open ended” in that you can use them to go to any organisation, while other fellowships are offered by specific organisations and are available for research at that organisation only. Many databases such as COS (Community of Science) [89], IRIS (Illinois Researcher Information Service) [90] and SPIN (Sponsored Programs Information Network) [91] contain detailed and up-to-the-minute information about thousands of government and private international fellowship funding opportunities, usually on a fee subscription basis. A number of the databases listed in other sections of this guide also list fellowship opportunities and details. Your research office or organisation’s staff should be able to assist you in determining the deadlines and requirements for these fellowships. It is very prestigious for an organisation to have their staff awarded these fellowships and your organisation will benefit greatly when you return.

Having spent time in another organisation, or possibly another country, you will have learned skills and expertise that are not available locally. Hence your organisation is likely to provide significant support for your application.

However, like much of the work described in this guide that will advance your research career, applying for fellowships is time - consuming and hard work. In addition, potentially moving to another part of your country or even overseas may involve significant family upheaval, so it is essential that you determine that your academic career is at the level it should be to compete against other fellowship applicants. You must decide that you are prepared to put in the time and effort and undergo the potential family upheaval in order to do the absolute best in carrying out the fellowship. I was very pleased and honoured to be awarded a Fulbright Fellowship that allowed me to carry out full - time research at the U.S. Department of Agriculture Research Institute. So naturally, I strongly recommend fellowships to you as a very significant part of your research career. They certainly are a very strong platform from which to catapult your research career. Good luck with your application.

References

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Applying for a Job or Promotion

Although there are clear differences between applying for a promotion or applying for a job, there are many similarities too so I will discuss them both together. And in fact, often the best way to get a promotion is to actually apply for a job at a higher level in another organisation.

If you are working at a university, then obviously you have a number of other very important activities to consider, such as teaching and administration services, as well as your research activities. If you are working in industry or a medical research institute, you will still have other responsibilities in addition to your research to take into account when applying for a promotion or another job. These are all very important activities, but this guide is focused on your research career only which, whether you are in a university, a commercial research organisation, or a government medical research institute, should still be your major focus.

You have followed the advice given in this guide, published in high - quality journals, received research grants, and been on a fellowship overseas. You now feel that it is time to apply for a promotion. However, it is very important that you do not apply for a promotion or a new job too early, as there is a very large amount of work that needs to be completed for both activities and being unsuccessful in either can be quite defeating. Obviously, not everyone gets promoted the first time around and only one person can be successful in obtaining the job, but it is important to be near the level required for either the promotion or the job to at least make the application worthwhile.

You may need excellent references from your research supervisor, your mentor, and probably senior members of your network, so it is important to get their advice and opinion as to whether they believe your research career is at a level worthy of the promotion or job. This is where critical comment is invaluable as continued requests for references from a supervisor, mentor, or network member who does not suggest that more work might be required, can cause a negative reaction, that will in time decrease the value of your relationship with them.

In addition to general input from colleagues, how can you determine whether your research career has reached the point where a promotion or new job is the next logical and achievable step?

Degrees of promotion or jobs at certain levels usually have general standards of research productivity associated with them. As your career progresses, you will see other colleagues promoted and given jobs and you will naturally get a feel for the level of productivity required to take your next career step. Each applicant is different and everyone should be judged on their own individual merits, but selection or promotion committees sit and make decisions based on their general experience in the area.

Many publications, some of which have already been mentioned earlier in this guide, say that promotion, job selection, or presentation of awards should not be based simply on quantitative analysis of one's publications. And I am certainly not suggesting that this should be the case. However, quantitative analysis of your research publications can be used to provide you with an approximate idea of whether your career is at a level consistent with an application for a promotion or a job, and I believe that more and more committees are including quantitative analyses as extra information in the decision - making process.

I am certainly not suggesting that because one of your colleagues was promoted to associate professor with only 15 publications and you have 22 that you should immediately apply for and be guaranteed promotion to that level. There are numerous other factors that come in to play in an assessment for a promotion or job, with regard to things such as author order and quality of the journal. However, I do believe that you should use analyses, with the various formats I have described here, to evaluate alongside the information you receive from your colleagues and peers to determine whether your career is at the right stage to apply for a promotion or job. The *h* index has been used to identify top scientists in such areas as physics, chemistry, and computer science [92] and give a base level for the selection of winners of the Price medal for outstanding contributions to the field of qualitative studies of science [93].

Clearly very few ECRs are at these levels, but studies have also been done investigating the *h* index of non - prominent physicists and promotion levels of assistant and associate professors in psychology [94,95]. Both of these studies highlight the potential pitfalls of using the *h* index for definitive specific personal comparisons. However, I believe that they do in fact show that you can use such analysis tools as the *h* index to get at least a general approximation of the level of your research productivity. You are then able to use it for your

own private comparisons with the results of peers who you know are at the level of promotion you are considering.

Once you have decided to apply for a promotion or a job, then you should put considerable time and effort into the process.

The suggestions I made for grant funding and selling your accomplishments earlier also apply here. Keep your CV accurate and up-to-date and above all when applying for promotion or job, do not over - embellish your accomplishments. Your productivity should certainly be highlighted and presented in a positive light, but it must be done accurately and honestly. Make sure your application is submitted within the timeline required.

Be specific about applying for a job and do not send out what amounts to spam. During my academic career, I used to get numerous letters addressed to "Dear Respected Sir" that had obviously been sent out to many other potential employers, who I am sure, also showed no interest. Such bulk mailings would actually be offensive to female recipients. If you are applying for a job, make sure that you know as much as possible about the position, the organisation, and the people that you would be working with so that you can perform at your best in both the application and at interview. There is merit in asking several close peers to give you a mock promotion or job interview, so that when you attend the real interview you are as well prepared as possible.

A career in research is an exciting adventure. You are fortunate to have been able to make the most of the opportunities presented to you and earned a Ph.D. Hard work and always aiming for high quality outputs will allow you to succeed, and indeed thrive, in the research environment. A research career is a most worthwhile calling in life as you add your new knowledge to advance humankind.

Good luck and I hope to see you present your outstanding results at a conference somewhere soon.

Alan Johnson

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Professor Alan M Johnson AM

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Emeritus Professor Alan Johnson AM has 30 years of experience in research, research management and research training in a range of organisations including universities, Australian Government agencies, and international research organisations.

He obtained his Bachelor's degree in biomedical technology from the South Australian Institute of Technology, followed by a Ph.D. in parasite immunology from Flinders University. On secondment from the Flinders Medical Centre during 1985 - 1986, he was a Fulbright Postdoctoral Research Fellow at the United States Department of Agriculture. He was awarded the 1989 Bancroft - Mackerras Medal of the Australian Society for Parasitology for outstanding research. In 1996, the University of Wollongong awarded him a Doctor of Science degree in protozoan biology. He was nominated "Ehrenmitglied" (honorary member) by the German Society for Parasitology in 1999 for both his outstanding research record and the fact that he trained a number of German postgraduate students and postdoctoral scholars in his laboratories.

During his research career, he published over 100 internationally refereed journal articles and received over $3.5 million in competitive grant funding.

Professor Johnson was awarded an M.A. (Hons) in technology and social change from the University of Wollongong in 1989 and an M.Ed.Mgmt. in the use of citation indexing to measure university department performance from Flinders University in 1991.

In recognition of his service to science in the field of molecular parasitology, to scientific research and education, and as Editor-in-Chief of the International Journal for Parasitology (published by Elsevier Science Ltd.) from 1997 - 2003, he was made a Member of the Order of Australia in 2006. In 2007, he was made a Distinguished Alumnus of Flinders University.

Between 1992 and 2002, he was Professor of Microbiology, Chair of the Academic Board, and a member of the governing Council of the University of Technology, Sydney.

In 2002, he was invited to be a member of the Australian Research Council's (ARC) College of Experts and from 2003 to 2006 he was seconded to the ARC as Executive Director for Biological Sciences and Biotechnology.

Under Professor Johnson's leadership as Deputy Vice - Chancellor (Research) and Vice - President at the University of Adelaide in 2006 and 2007, the university's annual research revenue exceeded $100 million for the first time.

In 2007, he established an international consultancy business, Research Management Services International Pty. Ltd. http://www.rmsinternational.com.au.

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